

Hawaii Fisheries Disaster Relief Program Final Report

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2. Title of Project: Tests of sea turtle responses to light sticks, shark silhouettes, and bait types.

3. Fishery Targeted: Gillnet fisheries, longline fisheries

4. Award received: \$84,251

Actual amount spent: \$84,251

+

5. Project Objectives:

The project's objectives were to examine sea turtle behaviors in order to develop strategies useful in reducing sea turtle interactions with fishing gear. Objective outlined in our proposal include:

- A) Examine the effect of lightsticks on sea turtle catch rates.
- B) Examine the effect of shark shaped silhouettes on sea turtle catch rates.
- C) Examine sea turtle behaviors during feeding.
- D) Provide outreach to urban youth under represented in the natural sciences

6. Describe how the objectives were met. Focus your response on the activities you accomplished with the award funding. You may also briefly present results if you choose. Your accountability is whether you spent your funding as you specified in your award proposal, with less importance given to the specific results.

For objectives A and B, experiments were conducted in the Estero Coyote near Punta Abrejos, Baja California Sur, Mexico (an area with known high rates of sea turtle captures). During May – September 2007 we carried out research trips into Mexico with each trip centered on the neap tide. This period of time coincide with the highest reported sea turtle catch rates. During these trips we conducted both night time as well as daytime experiments that lasted between two to 5 days. Over the course of these experiments, we captured, measured, and tagged a total of 267 green sea turtles (*Chelonia mydas*). Tagging and morphometric data were provided to Grupo Tortugero, a group of fishermen who monitor sea turtle populations in the area, for their long term monitoring database.

A. Examined the effect of lightsticks on sea turtle catch rates.

From approximately 1900 to 0700 hours, we examined the effects of net illumination by battery powered LED lightsticks (Lindgren-Pittman, Inc.) on the capture rates of green sea turtles on turtle monitoring nets. During each night, two 95 m long nets were deployed: a control net with inactive lightsticks every 10m and an experimental net with activated LED lightsticks placed every 10m. Nets were placed in 2 locations such that the distance between nets was less than 1.0 km. The location of the control and experiment net were swapped each night. All nets were standard turtle tangle nets made of monofilament line with a stretched diagonal length of 40cm. Nets were monitored for turtles every 90 minutes throughout the night.

Of the 134 green sea turtles caught during nighttime experiments, control nets captured 78 turtles while experimental nets capture 56 green sea turtles. The mean CPUE of control nets was 22.5 green sea turtles (SEM = 5.6) compared to the mean CPUE of the experimental nets, which was 15.5 green sea turtles (SEM = 3.8) (Fig. 3). This was a 31% reduction in CPUE from control to experimental nets. Analysis using the Wilcoxon paired-rank test indicates that this difference in CPUE was not significantly different (N=12, P >0.3) (see Fig 1).

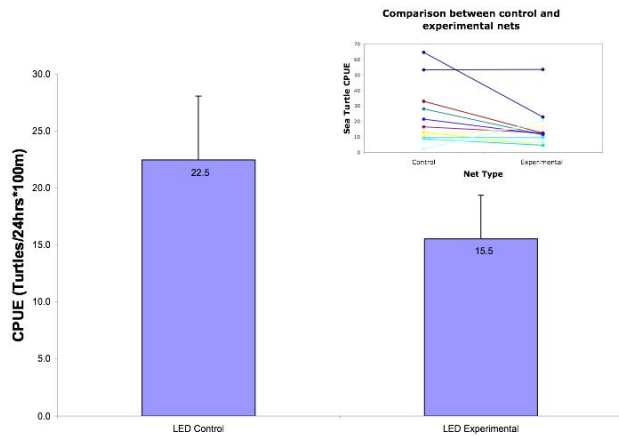


Figure 1. Comparison of mean CPUE of sea turtles on control nets (with inactivated LED lightsticks) and mean CPUE of sea turtles on experimental nets (with activated LED lightsticks). A total of 12 pairs of nets where deployed from 2006-2007. This was a 31% reduction in CPUE from control to experimental nets. Of the 12 trials, 9 resulted in having lower sea turtle CPUE in the experimental net (inset). Analysis using the Wilcoxon paired-rank test indicates that this difference in CPUE was not significantly different (N=12, P >0.3).

B. Tested the effect of shark shaped silhouettes on sea turtle catch rates.

From approximately 0700 to 1900 hours, we examined the effects of shark shapes on the capture rates of green sea turtles on turtle monitoring nets. During each day, two 95 m long nets were deployed: a control net with float buoys every 10 m and an experimental net with shark shapes hanging from float buoys every 10 m. Nets were placed in 2 locations such that the distance between nets was less than 1.0 km. The location of the control and experiment net were swapped each days. Nets were monitored for turtles every 90 minutes throughout the day.

We captured 133 green sea turtles during the daytime experiments with control nets capturing 85 turtles while experimental nets capturing 48 turtles. The mean CPUE of control nets was 24.2 green sea turtles (SEM = 6.3) compared to the mean CPUE of the experimental nets, which was 11.17 green sea turtles (SEM = 2.6) (Fig. 3). This was a 54% reduction in CPUE. Analysis using the Wilcoxon paired-ranks test indicates that this difference in CPUE was significantly different (N= 14, P < 0.01) (see Fig. 2).

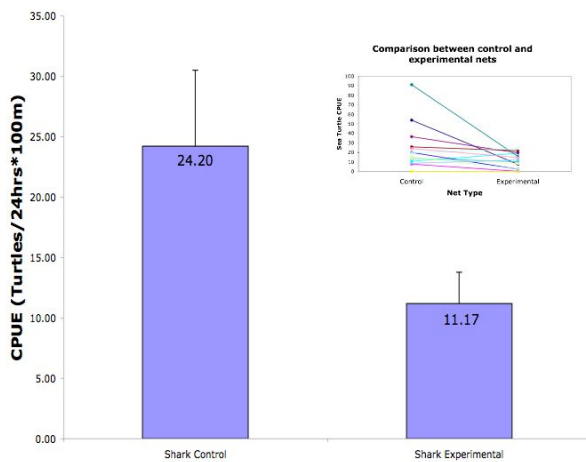


Figure 2. Comparison of mean CPUE of green sea turtles on control nets (without shark shapes) and mean CPUE of sea turtles on experimental nets (with shark shapes). A total of 14 pairs of nets where deployed from 2006-2007. This was a 54% reduction in CPUE from control to experimental nets. Of the 14 trials, 10 resulted in having lower sea turtle CPUE in the experimental net (inset). Analysis using the Wilcoxon paired-rank test indicates that this difference in CPUE was significantly different (N= 14, P < 0.01).

C) Analyzed feeding behaviors of sea turtles.

Initial experiments were conducted on captive sea turtles held in captivity at the Bahía de los Angeles Sea Turtle Facility. The feeding behaviors of 5 green sea turtles (*Chelonia mydas*), 2 olive ridley sea turtles (*Lepidochelys olivacea*), and 2 hawksbill turtles (*Eretmochelys imbricate*) were examined to determine if there were feeding differences between squid bait and fish bait. Analysis suggested no differences in time of first interaction with squid or fish bait. Underwater filming of additional behaviors was not successful in obtaining useable behavioral data due to the poor quality of the water in the facility tanks.

D) Outreach to underserved populations of high school students.

Through this collaborative research effort, Aquatic Adventures Science Education Foundation conducted an educational program that engaged low-income, urban youth in marine conservation research. Over the course of this work, 12 students from Hoover High School located in the high-poverty City Heights neighborhood of San Diego, California intensively studied the marine sciences and were directly involved in this research as research assistants. These students were part of the entire research process including presenting this work at national and international meetings (see below).

7. Discuss differences between work anticipated in your proposal and work that was actually completed.

Testing modified lightsticks. Initial experiments indicated that the illumination of commercially available LEDs on nets provided a visual cue to deter sea turtles. This particular visual cue could potentially be used in many different gillnet fisheries as a strategy to reduce sea turtle interactions. As such, we wanted to better characterize this initial finding and its potential role as a sea turtle visual deterrent.

Examining feeding behavior of sea turtles. We examined the behavior of 3 species of sea turtles during feeding experiments with squid bait and fish bait. Despite this initial work, we were not able to extend the work to underwater behaviors due to the water quality in the holding and experimental tanks. The infrastructure of the Bahía de los Angeles Sea Turtle Facility did not allow sufficient water exchange to occur.

Additional objectives achieved not outlined in initial proposal:

Training of local Mexican fishermen to report bycatch in a bottom gillnet fisheries.

Eight local fishermen from the town of Bahia de los Angeles, Baja California, Mexico were trained to report catch and bycatch from gillnets used in a bottom fisheries targeting guitarfish (*Rhinobatis productus/Zapteryx exasperata*) and shark species (*Mustelus spp*, *Rhizoprionodon longurio*). Fishermen were trained to conduct experiments designed to test the effects of lightstick illumination and shark shape visual deterrents in this fisheries. Fishermen were trained to fill out catch forms which include data on target species catch, bycatch species, as well as market value of catch. These fishermen will be involved in experiments examining the implementation of sea turtle bycatch strategies identified by the research funded by this project.

Collaboration on sea turtle feeding biomechanics with Chris Marshall (Texas A&M University at Galveston, TX).

Sea turtles are known for their biting ability. However, the bite force capability of sea turtles is not well understood. In collaboration with Dr. Chris Marshall, we utilized a bite force transducer, as a non-invasive method, to measure bite force of a variety of species of captive and wild-caught turtles. Bite force measurements of 30 green sea turtles (*Chelonia mydas*) were made. Results from this work can potentially yield useful biomechanical information leading to a better understanding of how sea turtles interact with longline hooks.

8. Discuss differences between expected and actual costs.

There were no significant differences in expected and actual costs.

9. List all publications, posters, brochures, and other informational material published with project funding. Submit copies of publications to JIMAR

Publications:

Swimmer, Y., and J. H. Wang. (2007). Sea turtle and pelagic fish sensory physiology workshop, September 12-13, 2006. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-11, 35 p.

Wang, J.H., Fisler, S., Swimmer, Y. (in manuscript). Developing sea turtle bycatch reduction strategies: testing visual alerts.

Presentations at International and national meetings:

Alva, E., Alvarez, A., Barraza, U., Dam, K.C., Figueroa, A., Trujillo, E., Peavey, L., Fisler, S. Swimmer, Y., Wang, J., Reyes, C.G., Gonzalez, A.Z. (2008). Developing sea turtle bycatch reduction strategies with lightsticks and shark shapes. Proceedinfs of the 28th International Symposium on sea turtle biology and conservation, Loretto, Baja California Sur, MX.

Wang, J.H., Fisler, S., Swimmer, Y. (2007). Developing strategies to reduce sea turtle bycatch: using lightsticks and shark shapes. 4th International Fishers Forum. Punta Arenas, Costa Rica.

L., Barraza, U., Cueva, L., Figueroa, A., Rangel, N., Silas, S., S., Hall, Swimmer, Y., Fisler, Wang, J.H. (2007). Developing strategies to reduce incidental capture of sea turtles. 2007 Annual Society for Integrative and Comparative Biology Meeting, Phoenix, AZ, USA.

Wang, J.H., Swimmer, Y., Fisler, S., Hall, L., Barraza, U., Cueva, L., Figueroa, A., Rangel, N., Silas, S. (2007). Developing strategies to reduce incidental capture of sea turtles. *Proceedings of the 27th International Symposium on sea turtle biology and conservation*. Myrtle Beach, South Carolina.